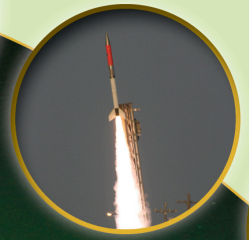
Sounding Rockets



Sounding Rocket Working Group

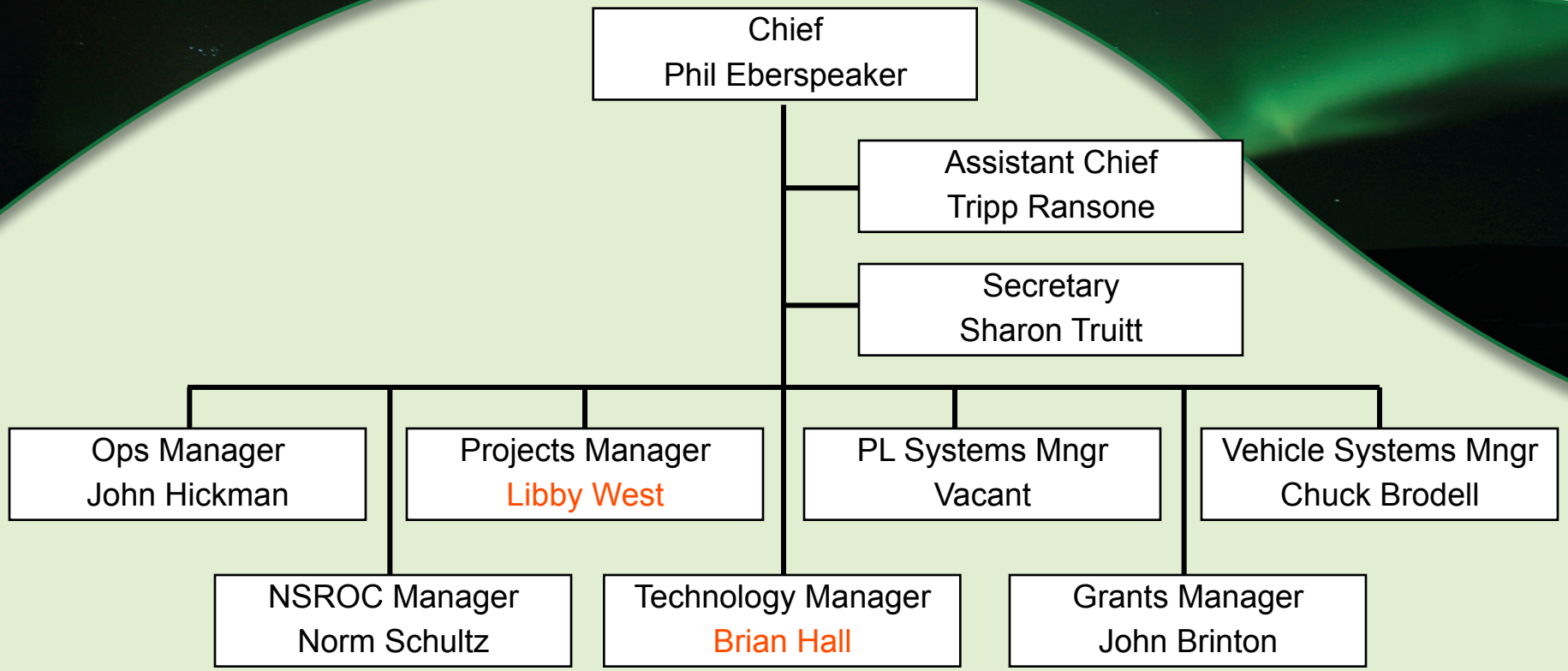
December 10 – 11, 2008

SRPO Briefing Outline

- Program Overview - Eberspeaker
  - Mission Results Summary (since last meeting)
  - FY09-FY11 Manifest
  - Mishap/Anomaly Investigation Status
- NSROC II Status - Ransone
- Poker Winter Campaign Status - West
- Launch Ranges - Hickman
  - Poker Upgrade Concept
  - WSMR Consolidation
  - Kwajalein
- White Sands Operations Trends - Hickman
- Rocket Motor Status - Brodell
- ITAR

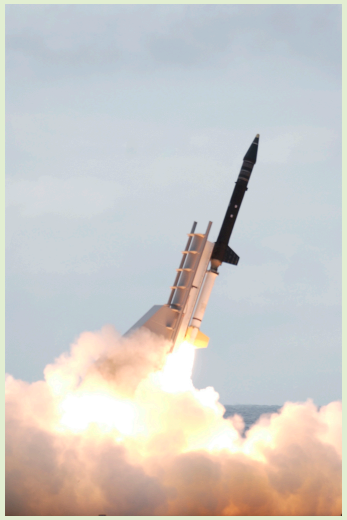
- Findings from January SRWG Meeting

SRPO Staffing



Missions Flown Since Last SRWG

- Core
  - 36.207 Kowalski
    - Success
  - 41.074 SubTech
    - Success
- Reimbursable
  - 2x Terrier-Orion
    - Success
  - 1x Terrier-Oriole
    - Success
- 100% Success in FY08
  - 12 Core
  - 1 Reimbursable



FY09 Schedule

#	Vehicle Type	FY 2009 Experimenter	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
		WALLOPS ISLAND												
1	Test Vehicle	Hall/NASA-WFF							△					
2	Terrier Orion	Koehler/Univ. of Colorado									△			
		WSMR												
3	Black Brant IX	Kowalski/NRL		▲										
4	Black Brant IX	Moses/NRL				△								
5	Black Brant IX	Bock/Cal Tech					△							
6	Black Brant IX	Green/Univ. of Colorado								△				
7	Black Brant IX	Davis/MSRF							△					
8	Black Brant IX	Korendyke/NRL							△					
9	Black Brant IX	Hassler/SWRI									△			
10	Black Brant IX	Cash/Univ. of Colorado									△			
11	Black Brant IX	Chakrabarti/Boston University (TBD)												
		PFRR												
12	Black Brant IX	Bounds/University of Iowa				△ }								
13	Black Brant VB	Bounds/University of Iowa				△ }								
14	Orion	Thorsen/University of Alaska				△								
15	Black Brant XII	Lynch/Dartmouth College					△							
16	Terrier Orion	Lehmacher/Clemson University					△ }							
17	Terrier Orion	Lehmacher/Clemson University					△ }							
18	Terrier Orion	Lehmacher/Clemson University					△ }							
19	Terrier Orion	Lehmacher/Clemson University					△ }							
		REIMBURSABLE MISSIONS												
20	Terrier Orion	Murbach/NASA-AMES						△						
21	Black Brant IX	MARTI/USAF-ABL							△					
22	Black Brant IX	MARTI/USAF-ABL							△					
23	Black Brant XI	Bernhardt/NRL							△					
24	Black Brant IX	MARTI/USAF-ABL									△			
25	Black Brant IX	MARTI/USAF-ABL									△			
26	Black Brant IX	Cheatwood/NASA-LARC										△		
27	Terrier Orion	Bull/Sub-TEC III/NASA-WFF							△					
28	Black Brant IX	MARTI/USAF-ABL (TBD)												
29	Black Brant IX	MARTI/USAF-ABL (TBD)												
30	Black Brant IX	MARTI/USAF-ABL (TBD)												
31	Orion	Winstead/NAWC (TBD)												
32	Orion	Winstead/NAWC (TBD)												

Current Planning Manifest

- FY10
  - 12 flights currently on the planning manifest
    - 8 WSMR
    - 3 Poker
    - 1 Norway
- FY11
  - 5 flights currently on the planning manifest

Failures and Anomalies

Failure	AIB lead	Status
IRVE Failure – 41.055	NASA - GSFC	Official report has yet to be released by NASA HQ, but SRPO and NSROC are incorporating appropriate corrective actions (closed as far as the SRPO is concerned)

Anomalies	Lead	Status
- Mesquito	NSROC	Next round of test flights on schedule. Booster fin mounting has been improved.
- ACS reset on recent mission	NSROC	Modified board – mods flown (closed)
- Loss of TM Frame Synch and general high voltage issues	NSROC	TM problem attributed to the high voltage problem. No issues identified within TM design. Some components within the HV system were identified as susceptible to HV arcing.

NSROC II

- Key Features
  - Full and Open Competition
  - Single Award
  - Five Year Period of Performance
    - No options
  - Indefinite-Delivery Indefinite-Quantity (IDIQ)
  - Cost-Plus-Incentive Fee (CPIF)
- Draft RFP under review at Goddard
  - Expect to release for comments in early 2009
- NSROC I extended until at least July 2009

Poker Winter Campaign Status

- Thorsen
  - Complete with T&E
  - No issues during integration and test
  - Payloads and GSE shipped in September
  - MRR Scheduled for December 11, 2008
  - Field Integration begins December 29, 2008
  - Launch Window: January 10 – 11, 2009

- Bounds
  - Wrapping up T&E – Air bearing tests
  - Only minor issues encountered during integration and test
  - MRR Scheduled for December 16, 2008
  - Payload and GSE shipment schedule for December 19, 2008
  - Field Integration begins December 29, 2008
  - Launch Window: January 13 – February 4, 2009

Poker Winter Campaign Status

- Lehmacher
  - Only minor issues encountered during integration and test
  - MRR complete October 6, 2008
  - Payload and GSE shipment arrived at Poker November 29, 2008 with the motor shipment.
  - Field Integration begins January 14, 2009
  - Launch Window: February 11 – March 3, 2009
- Lynch
  - Integration and Pre-Vibe sequence testing complete.
  - T&E underway
  - MRR scheduled for January 7, 2009
  - Payload and GSE shipment scheduled for January 12, 2009
  - Field Integration begins January 20, 2009
  - Launch Window: February 11 – March 3, 2009

Poker Winter Campaign Status

- Fixed TM
  - Redstone, 16 ft – GREEN
  - TOTS – GREEN
  - 11M – System GREEN – supporting in shadow mode
- Mobile TM
  - 20 ft System - GREEN
- Radar
  - Radar 10 – GREEN
- IIP
  - Software upgrades in process
- Computer Support
  - Look Angles for Thorsen and Lehmacher - Complete
  - Look Angles for Bounds and Lynch - Awaiting final trajectory data
- Staffing - Green

Poker Winter Campaign Status

- **Ground Safety**
  - All Risk Analysis Reports complete
  - All Ground Safety Plans complete
- **Flight Safety**
  - Bounds
    - Draft Risk Analysis Reports complete
    - Draft Flight Safety Plan complete
    - PI, NSROC, Safety, and Poker working on finalizing optimal trajectory.
  - Thorsen
    - Draft Risk Analysis Report complete – final in review
    - Draft Flight Safety Plan complete – final in review
  - Lehmacher
    - Final Risk Analysis Reports in review
    - Final Flight Safety Plans in review
  - Lynch
    - Draft Risk Analysis Report underway
    - Draft Flight Safety Plan underway
- **Outstanding Items**
  - Poker Contract Modification for Safety Criteria

Poker Upgrade Concept

- Some funding has been set aside for facility upgrades at Poker in the SRPO budget
  - Less progress has been made on plans for prioritizing these upgrades…plan to work on this in Jan/Feb
  - SRPO #1 goal - Create PFRR Consolidated Control Center
    - Purpose is to alleviate overcrowding in the blockhouse and consolidate decision makers into one central location
      - PI, Range Director, Ops Controller, Campaign Manger, Safety, Mission Manger
    - Safety requirement to move non-essential personnel from hazard areas……result of Delta II incident at KSC
      - Personnel in the blockhouse were injured
    - Can be done within and existing facility or with minimal modification to existing facility
      - Science Ops Center is an excellent location

WSMR Consolidation

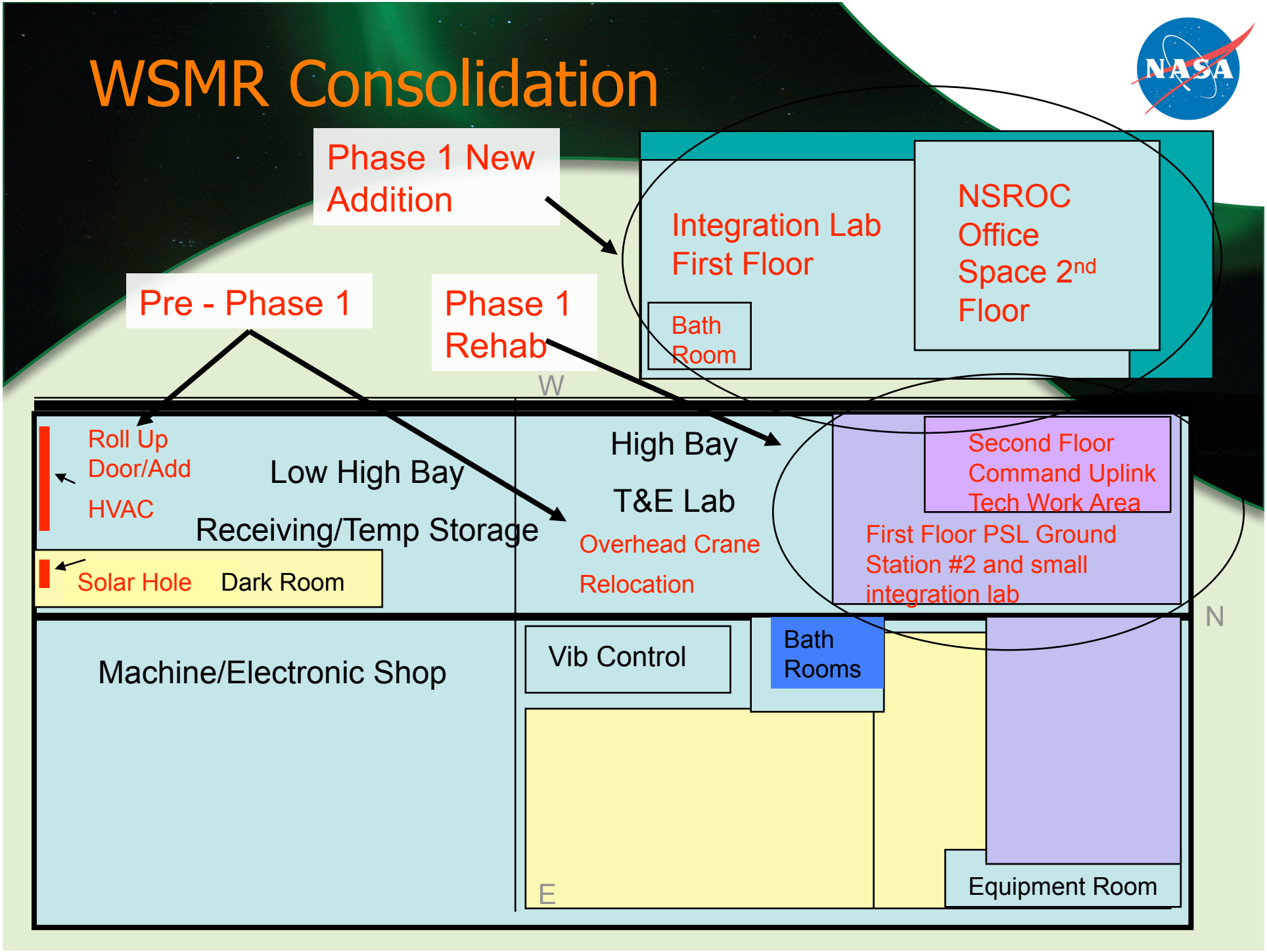
- Plans underway to consolidate LC35 & LC36 operations at WSMR
  - Address long standing PI concerns/recommendations, cleanliness, more efficient operations
  - Facility utilization & energy cost savings
  - Opportunity to improve 30+ year old "worn out" integration facility…cleanliness control is a top goal
- Currently planned as a two year effort
  - Navy, NSROC, NASA have collaborated on these plans to give us the most bang for our buck……typical sounding rocket approach
  - Two phases to the construction and rehab will have minimal impact on launch operations
  - Both LC 35 and LC 36 will be maintained until the construction/rehab is complete

WSMR Consolidation

WSMR Consolidation

- Pre-Phase I – "getting ready" phase using existing funds
  - Replace low bay exterior door
  - Add HVAC to low bay (help with contamination control)
  - Reconfigure overhead crane in high bay to service the entire bay area
- Phase I – drawings at 30% level
  - Addition of new integration lab and office space on NW corner of VAB
    - First floor integration lab with positive ventilation
      - Internal clean tent, lab benches, rest room, etc.
    - 2nd floor predominately office space
      - Both permanent and transient
  - Rehab of High Bay area
    - Add walls/floor to create a 2 story addition in north end of high bay
      - Upper part for NSROC technician work area and command uplink room
      - Lower part divided between small integration area and room for addition of 2nd PSL ground station

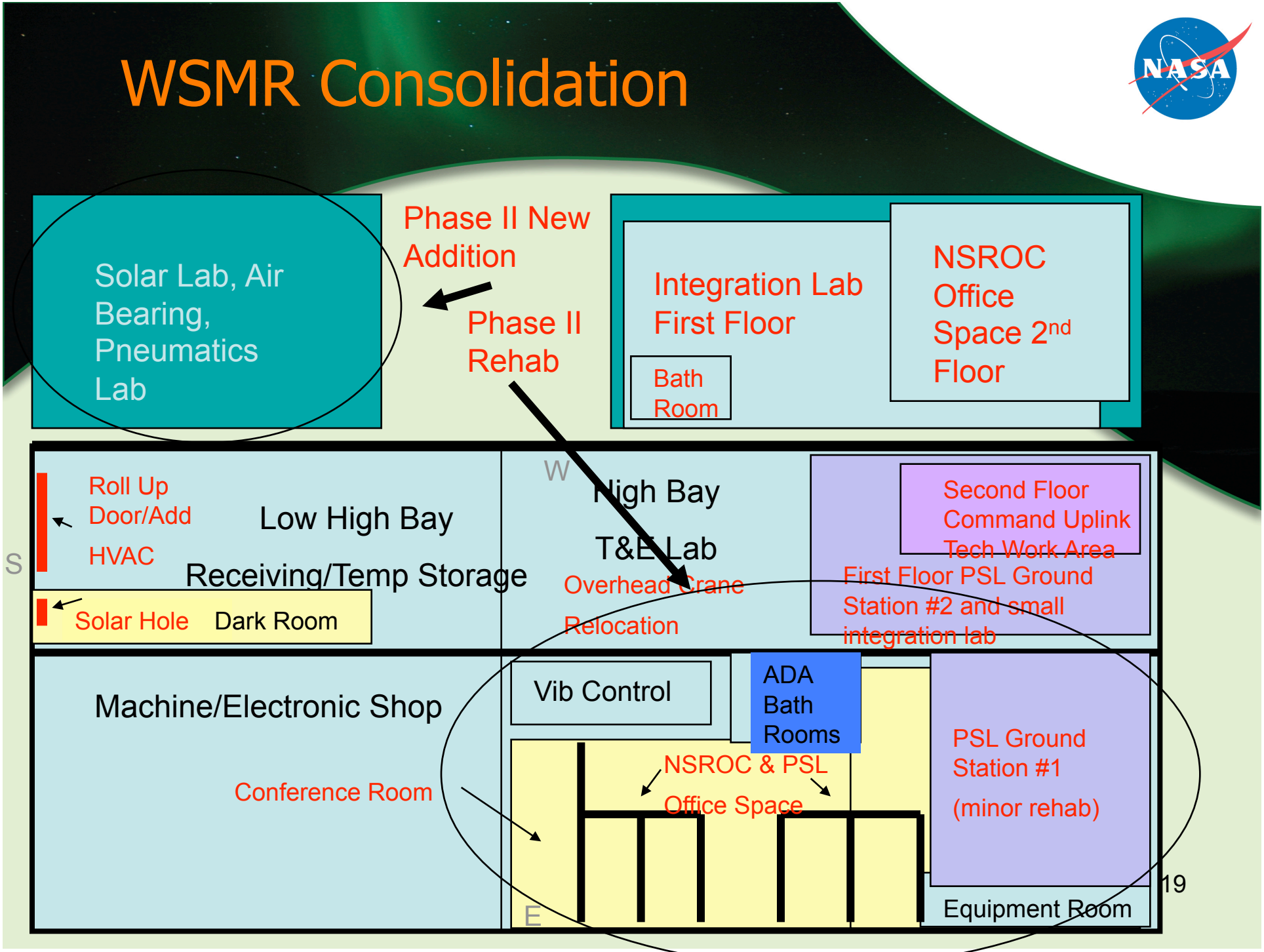
WSMR Consolidation



WSMR Consolidation

- **Phase II – drawings at 15% level**
  - One story addition on SW corner of VAB
    - Provide space for remainder of LC 35 lab and test equipment
    - Dedicated solar lab
    - Pneumatics Lab
    - Air bearing room
    - Possible small integration and/or test area
  - Rehab of NE side of existing VAB
    - Make office space for NSROC and PSL personnel
    - Conference Room
    - ADA compliant rest rooms
    - Ground station area rehab (possibly)
    - Add vestibule entrance (contamination control)

WSMR Consolidation



WSMR Operations Trends

Schedules

- Recent trend at WSMR of SRPO missions ***not*** making requested/scheduled launch windows
  - Impacts our ability to obtain priority for future missions as our credibility is being eroded
  - Increased operations cost a secondary factor
- SRPO working with WSMR to work out a plan to address this concern
  - WSMR is a heavily used range and has multiple events scheduled every day
- May need to set "minimum" milestone before hard launch date is scheduled
  - e.g. successful sequence, MRR complete, etc.
- Schedule meeting conducted every Wednesday for actual events 4 weeks out
  - Possibility exists of obtaining earlier launch dates but no guarantee's

WSMR Operations Trends

Foreign National Access

- New security requirement levied on program for access of foreign nationals
- Requirement to send memo vouching for FN employer
  - For FN's who do NOT work for their respective government, standard approval process is adequate
  - FN's who work for their respective gov't, access must be coordinated through State Dept.
- Cognizant organization required to send letter to SRPO vouching for FN employment status
  - PI is responsible for send this letter on behalf of FN collaborators
  - SRPO will coordinate with HQ and WSMR

Kwajalein Option

- Over past couple of years SRPO has been researching ways to cost effectively conduct equatorial launches
- Reagan Test Site in the Kwajalein Atoll is most viable candidate
  - Take advantage of existing launch infrastructure maintained by the Army
  - Other options are too costly and/or involve safety or geopolitical risk that are unacceptable
    - Full range mobilization required is most cases

Kwajalein Option

- New concept of operations developed for Kwaj based on EQUIS II experience
- This model was submitted to RTS in late 2006 for cost estimation and results were favorable
- Goal is to "test the waters" to see what routine missions might cost
- With data provided, we believe we can conduct a limited mission within our existing budget profile
  - Assuming no major reductions in coming years

Kwajalein Option

- Concept of Operations
  - Utilize existing RTS infrastructure
    - No WFF mobile instrumentation
    - Use existing buildup and integration facilities
  - One "moon down" launch window
    - No extensions
  - Two launchers maximum
    - One RTS launcher (WFF refurbed in 2004)
    - One WFF provided launcher
  - Complete integration at least 12 weeks prior to payload arrival at launch site
    - Reduce shipping/air freight costs
  - Altair – use operating modes established for EQUIS II
    - Modifications will increase cost

Kwajalein Option

- Cost – Based on previous ConOps
  - ~$500K to reestablish capability, set up, and prelaunch activities
  - ~$300K for launch operations
    - One "moon down" window
  - Altair - ~$8K (believe this to be per night but estimate was not clear)
- Cost profile consistent with SRPO budget projections
- SRPO optimistic that Kwaj will make it into the 2009 ROSES announcement
  - Earliest we could be ready summer 2011

Rocket Motors

- Black Brant
  - Current delivery of 18 units underway
    - Current production rate is 2 units per month
    - Max capacity is 3 units per month
  - Order placed for 10 additional units
  - Review team investigating performance concerns
    - New MK1 not meeting performance expectations
    - Observing unexpected pressure decay during burn
    - Have observed a "spin up" phenomena at end of burn
- Nihka
  - Redesign effort moving forward to incorporate available materials
  - 9 units have been ordered
  - Delivery to begin once Brant order is filled
  - Inventory can cover current manifest requirement

Rocket Motors

- Talos
  - 26 at WFF and 24 stored at Hawthorn
  - Indian Head is gearing up to support Talos refurbishment program
  - Sending 12 motors to Indian Head to initiate refurbishment
- Terrier MK70
  - 86 at WFF
  - 88 tagged for NSRP though the Navy
  - 200 recently transferred from the AF (176 located at Hawthorn)
- Improved Orion
  - 99 at WFF (27 may not be usable)
  - Working on acquisition of 100 of recent (mid 90s) production
- Improved Malemute
  - 10 at WFF
  - Working towards first NASA flight in April
- MLRS
  - 54 at WFF

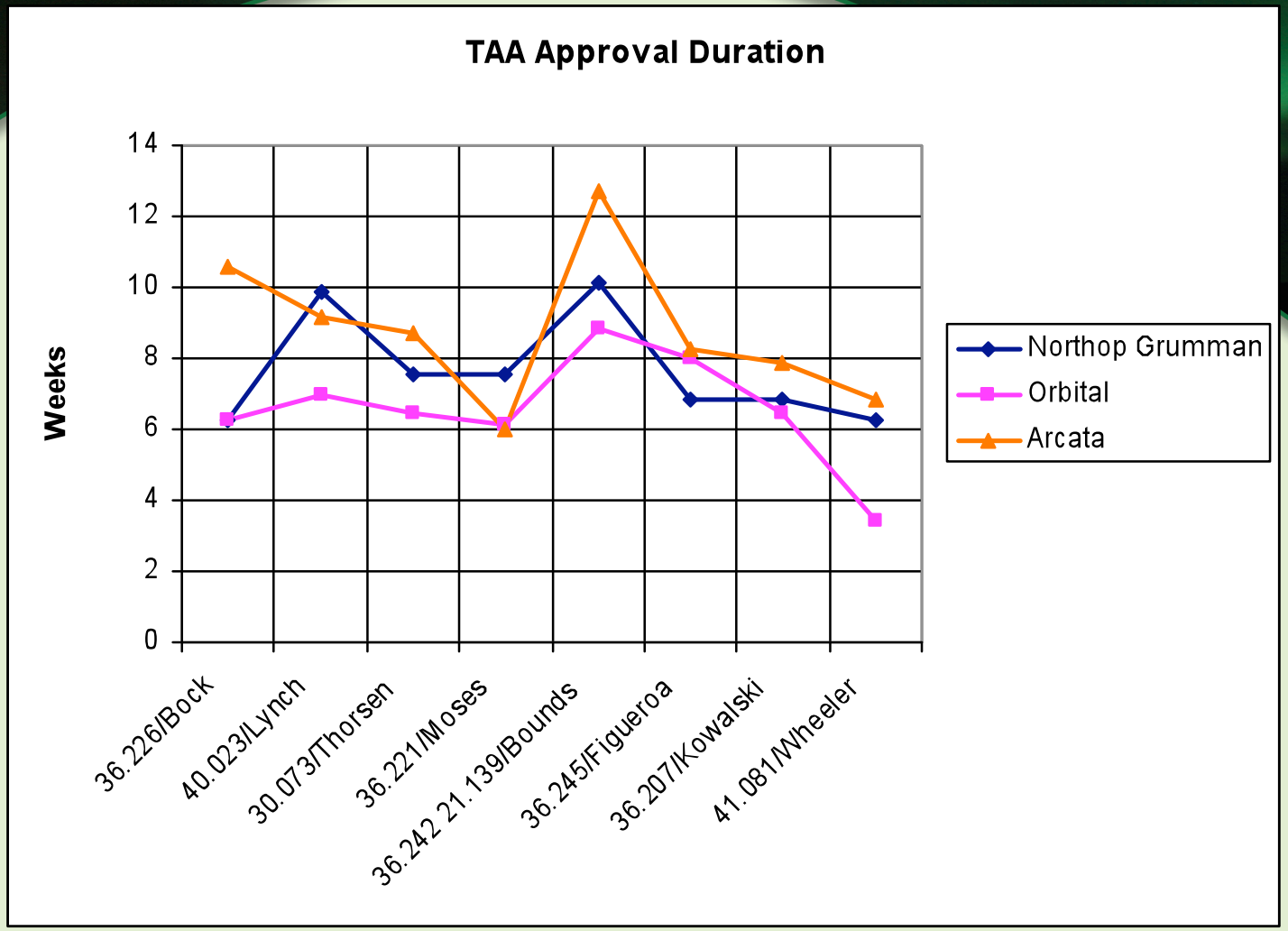
ITAR

- NASA is currently working to resolve TAA provisos that insert NSROC into the Universities' relationship with foreign nationals
  - NSROC's TAA's are between NSROC and the Foreign Nationals
  - NSROC has no legal authority to deal with the relationship between a university and the foreign national students/professors/ participants

ITAR

- Currently TAA's need to be in place before Foreign Nationals can participate in reviews
  - NASA will attempt to get DR data classified as non-ITAR controlled in hopes of alleviating some processing pressure

ITAR


TAA Approval Duration
Weeks
14
12
10
8
6
4
2
0
36.226/Bock
40.023/Lynch
30.073/Thorsen
36.221/Moses
36.242 21.139/Bounds
36.245/Figueroa
36.207/Kowalski
41.081/Wheeler
Northop Grumman
Orbital
Arcata

Findings from July 2008 SRWG

Technology Roadmap

- High Altitude Sounding Rocket
  - No direct effort underway
  - Spin-offs from other efforts could have application
- Mesospheric Miniaturized Rocket
  - Four more test flights scheduled for the coming months
  - Details to be provided as part of the NSROC presentation

Technology Roadmap (cont)

- Water Recovery of Astrophysics & Solar Payloads
  - No effort currently underway
  - Sealing of ACS and S-19 will be complicated (maybe impossible?)
  - Long impact ranges pose a problem
    - Use of S-19 would help, but creates other issues

Technology Roadmap (cont)

- High Data Rate TM
  - Range acquired 11m antenna at Poker after commercialization of AGS
    - X-band capable
  - Hybrid Team being formed to develop and fly concept system
    - NASA and NSROC joint team
  - Looking at test flight in Jan 2010 from Poker
    - Piggy back experiment on LaBelle mission
    - Will not play into mission success criteria
  - Should deliver 150 – 200 Mbps
  - Recent frequency authorization request submitted was denied
    - Looking to resubmit at "temporary" license

Southern Hemisphere Launch Sites

- Kwaj
  - An operations "experiment" will be a possibility under the next ROSES
- Woomera
  - The range is still active
  - Still the potential to leverage operations associated with other reimbursable customers
  - Currently no study effort

Findings from July 2008 SRWG

Ground-based Science Instrument Support within Poker Contract

- Contract with UAF does specify the contractor will operate and maintain downrange facilities at Fort Yukon and Kaktovik
  - Wording is somewhat vague
- Informal coordination used to cover current Poker Campaign

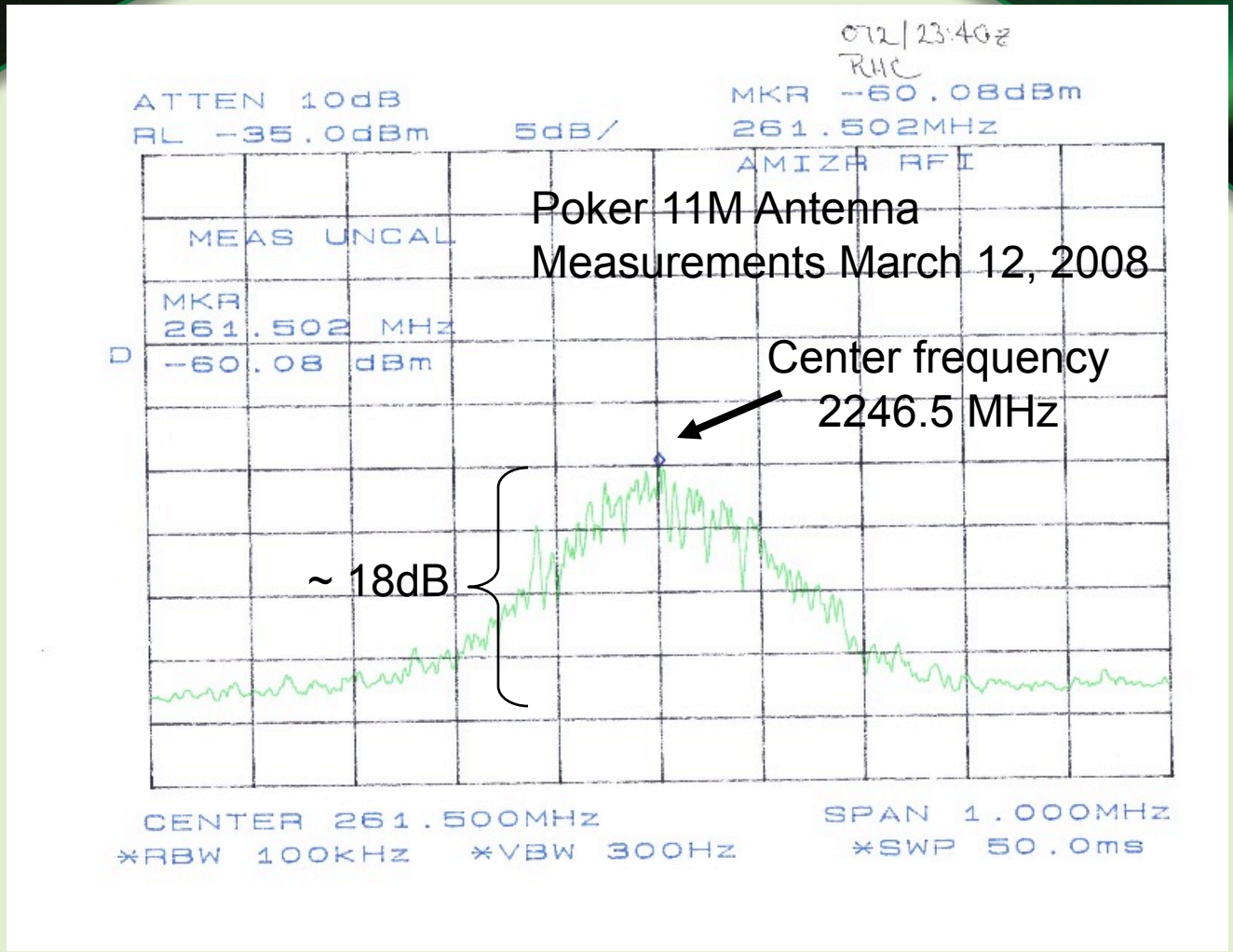
Findings from July 2008 SRWG

Mitigating PFISR Interference at Poker

- Our investigations over the past year have confirmed that AMSIR does create S-band interference problem
- Source is likely the result of SSPA's on some of the AMISR antenna elements
- At 2246.5 MHz – noise floor was raised approximately 18 db (see next slide)
  - Appears to be a function of antenna elevation
  - Further tests are necessary
- Bound Missions – interference appears to be between link frequencies
  - Will likely be permitted to remain ON during flight
- Lynch Mission – interference will likely impact one or more links
  - More work required to determine whether system can remain ON during flight
- RF silence – Range Safety has rendered decision that AMISR can remain ON during routine pad operations
  - Will be turned OFF during ARMING

Findings from July 2008 SRWG

Mitigating PFISR Interference at Poker



Findings from July 2008 SRWG

Restoring Wallops Ionosonde Capability

- The WFF Range and Mission Management Office, Code 840, will maintain the existing (old) ionosonde as part of the range infrastructure
  - The SRWG or other users need to provide the hardware and expertise to get the system operating again
  - Assumes minimal funds are required to keep it operational once it is back on line

- WFF does not have the expertise to complete the new Dynasonde nor maintain it at this time
  - The SRWG is encouraged to find an organization willing to sponsor and complete the installation/setup of this system
  - Future negotiations with the RMMO and SRPO are encouraged once the system is up and running

Findings from July 2008 SRWG

Praise for Wallops Sounding Rocket Annual Report

- Thanks…